

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
17 July 2003 (17.07.2003)

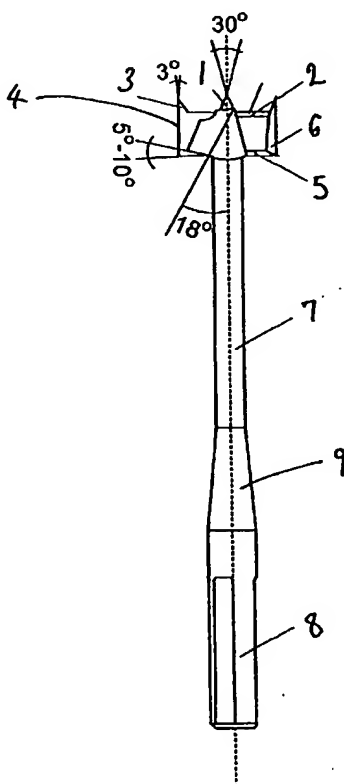
PCT

(10) International Publication Number  
**WO 03/057437 A1**

- (51) International Patent Classification<sup>7</sup>: **B27G 15/00**
- (21) International Application Number: **PCT/GB03/00087**
- (22) International Filing Date: **14 January 2003 (14.01.2003)**
- (25) Filing Language: **English**
- (26) Publication Language: **English**
- (30) Priority Data:  
**0200694.8**      **14 January 2002 (14.01.2002)**      **GB**
- (71) Applicants (*for all designated States except US*): **TCL SUPPLIES LTD.** [GB/GB]; 213 Portland Road, Hove, East Sussex, BN3 5LA (GB). **HANGZHOU XIAOSHAN JIAJIA TOOLS CO., LTD** [CN/CN]; Shi Yan Xiaoshan, Hangzhou, Zhejiang 311203 (CN).
- (72) Inventors; and  
(75) Inventors/Applicants (*for US only*): **DAVIES, Anthony** [GB/GB]; **TLC SUPPLIES LTD.**, 213 Portland Road, Hove, East Sussex, BN3 5AL (GB). **XIANG, Han Shui** [CN/CN]; **HANGZHOU XIAOSHAN JIAJIA TOOLS CO., LTD**, Shi Yan Xiaoshan, Hangzhou, Zhejiang 311203 (CN).
- (74) Agents: **LOCK, Graham, James et al.**; Fry Heath & Spence, The Gables, Massetts Road, Horley, Surrey RH16 7DQ (GB).
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,

[Continued on next page]

(54) Title: **DRILL BIT**



(57) Abstract: A high performance and versatile drill bit, for drilling curved bores, milling, countersinking and other application. A drill bit comprises a crown (6) and a shank (7) extending from the crown comprises at least three cutting blades.

WO 03/057437 A1



SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## Drill Bit

The present invention relates to a high performance and versatile drill bit, for drilling curved bores, milling, countersinking and other applications.

5

Within the context of this specification the word "comprises" is taken to mean "includes, among other things". It is not intended to be construed as "consists of only".

Conventional drill bits, such as flat drill bits and twist drill bits, comprise cutting  
10 blades capable of cutting only in a forwards direction. These drills lack versatility, being able to only cut straight holes. Separate tools, for example milling tools or countersinking bits, are needed if it is required to cut grooves, recesses or the like. In many situations it is desirable to drill a curved hole, for example to allow insertion of a flexible tubing without subjecting it to detrimental bending. Conventional drill bits  
15 are only capable of producing bores to round corners that include sharp angles.

In addition to their limited scope of use, the cutting performance of known drill bits is generally limited, with drill bits often having a poor cutting speed and smoothness of cutting. Limitations arise due to factors such as a requirement for the application of  
20 heavy pressure or frequent clogging of the drill bit with saw dust.

A versatile drill bit would provide the great advantage of enabling diverse applications, for example the cutting of recesses for installing locks and drilling of curved bores for installing cables or tubing, to be carried with greater ease and without the requirement for the use of multiple tools.

5

Drill bits are known that have the ability to cut in three directions. The known "3D bit" described in European Patent 0181841 is a drill bit for cutting wood and other soft materials. It comprises a crown having two forward (axial) cutting edges, two side (radial) cutting edges and two rear (axial) cutting edges. This arrangement of cutting edges enables the cutting of grooves, recesses and curved bores, in addition to straight bores.

10

The present invention provides a new highly versatile drill bit with a cutting blade geometry that provides a remarkably improved cutting performance over all known drill bits.

15

In a first aspect the present invention provides a drill bit comprising a crown and a shank extending from the crown, wherein the crown comprises at least three cutting blades.

20

Preferably an embodiment of a drill bit according to the present invention provides a drill bit wherein the crown comprises an odd number of cutting blades.

Preferably an embodiment of a drill bit according to the present invention provides a drill bit wherein the crown comprises three cutting blades. More preferably the three cutting blades are disposed from the longitudinal axis of the drill bit at an angle of 120° with respect to each other. Even more preferably each three cutting blade is  
5 identical.

Preferably an embodiment of a drill bit according to the present invention provides a drill bit wherein each cutting blade comprises a first axially cutting face, a radially cutting face and a second axially cutting face. More preferably each cutting face  
10 comprises at least one cutting edge.

Preferably an embodiment of a drill bit according to the present invention includes a first axially cutting face having a first axially cutting edge that bisects a radius of the crown. More preferably the first axially cutting edge trails the radius of the crown,  
15 relative to the intended direction of rotation for cutting. In contrast, preferably the trailing edge of the first axially cutting face lies on a radius of the crown.

Preferably an embodiment of a drill bit according to the present invention comprises a cutting blade having a wing. Preferably, the wing is wedge shaped. More preferably  
20 the wing extends circumferentially from the end of each blade distal to the central longitudinal axis of the crown. More preferably the wing has a curved outer face. Even more preferably, each wing extends circumferentially from the face of a blade

4.

adjacent the first axially cutting edge and the projecting edge of each wing forms a radially cutting edge.

Preferably each cutting blade is provided with a wedge shaped tooth that projects from the blade in an axial direction to a greater extent than the first axially cutting face.

More preferably the tooth tapers to form a third axially cutting edge. Even more preferably the third axially cutting edge is provided proximal to the first axially cutting edge. Furthermore, the third axially cutting edge is curved from a first end where it meets the radially cutting edge to a straight portion at its opposing end on top of the crown.

Preferably an embodiment of a drill bit according to a first aspect of the present invention has a crown that comprises an axial tapered cutting tip positioned on the longitudinal axis of the drill bit wherein the cutting tip projects in an axial direction further from the shank than any other part of the crown. More preferably the cutting tip is tapered at an angle of about  $20^{\circ}$  to about  $40^{\circ}$ . Even more preferably the cutting tip tapers at an angle of about  $25^{\circ}$  to about  $35^{\circ}$ . Even more preferably the cutting tip tapers at an angle of about  $30^{\circ}$ .

Preferably the tapered cutting tip is pyramidal and has three sides which are tapered at the angles described above.

Preferably an embodiment of a first aspect of the present invention comprises an attachment portion for a drilling machine positioned adjacent the shank distal to the crown. More preferably the attachment portion is of a wider diameter than the shank. Even more preferably there is a collar between the shank and the attachment portion, increasing in diameter from that of the shank to that of the attachment portion. Even more preferably the collar has a rough texture for providing grip.

A preferred embodiment of a drill bit according to the present invention provides a drill bit comprising a titanium nitrate ( $\text{TiNO}_3$ ) coating.

10

Preferably an embodiment of a drill bit according to the present invention provides a drill bit comprising 1060 high carbon steel and is of the hardness HRC 45-55.

An advantage of the present invention is that it provides a drill bit comprising at least three cutting blades, rather than the known arrangement of two cutting blades, thereby increasing the speed of cutting and smoothness of cut.

A further advantage is that the cutting blades are more stable while cutting, thereby reducing the chatter or vibration of the drill bit when in use. The chatter of a drill bit according to this invention is reduced relative to known drill bits when cutting in any one of the possible cutting directions. The reduction of chatter is most substantial when the drill bit is used for milling in a radial direction.

A further advantage of the present invention is that it provides a drill bit that has a smoother radial cutting action than known drill bits. The cut produced is cleaner and more accurate than that produced by any known drill bit.

- 5 A drill bit according to this invention has a particular advantage when being used to cut a channel in a surface. A reaction force, or angular friction, is generated by each radial cutting edge or wing. The direction of this force has a stabilising effect and reduces any tendency of the drill bit to jump out of a channel whilst cutting. This advantage arises due to the particular geometry of the cutting blades in relation to the
- 10 central axis of the shaft and the direction of rotation. In contrast to the invention, the cutting blades of known drill bits are positioned so that they precede the radius, rather than trail it. In these circumstances, the reaction force generated is directed out of the channel and a tendency of a drill bit to jump out of the channel is increased.
- 15 A further advantage of the present invention is that it provides a drill bit with improved cutting of wood, ejection of wood chips and thereby improved cutting speed. The gap between the cutting blades of the present invention has a larger volume than in known drill bits. Consequently the drill bit of the invention is less likely to clog with excess wood chips.

20

An advantage of the present invention is that it provides a drill bit comprising a cutting tip that is designed to prevent slipping. The tapered cutting tip of the present invention

preferably has three sides and comes to a sharp point. It is less likely to slip than the known four-sided cutting tips of known drill bits, wherein the tip tapers to a less sharp point.

- 5 An advantage of the present invention is that it provides a drill bit comprising a  $\text{TiNO}_3$  coating, providing an increase in the hardness of the drill surface. A  $\text{TiNO}_3$  coating thus provides a drill bit with a greater resistance to wear and therefore extends the working life of the drill bit.
- 10 A further advantage of a  $\text{TiNO}_3$  coating is a reduction of friction, thereby favourably reducing the operating temperature of the drill. Additional advantages of a  $\text{TiNO}_3$  coating are that it serves to inhibit corrosion and provides an attractive shiny finish to the drill bit.
- 15 The improved drilling performance of a drill bit according to this invention allows a drill bit to be manufactured from a reduced hardness of steel whilst still achieving the same cutting speeds as with known drill bits. Conversely, a drill bit according to this invention, comprising high performance steel gives a significant increase in performance over known drill bits of this type, enabling drilling of harder materials
- 20 than was previously possible.

8.

Additional features and advantages of the present invention are described in, and will be apparent from, the description of the presently preferred embodiments which are set out below with reference to the drawings in which:

- 5 Figure 1 shows a side view of a preferred embodiment of a drill bit according to the present invention.

Figure 2 shows an end view of three cutting blades of a crown of a preferred embodiment of a drill bit according to the invention.

10

Figure 3 shows a view along the longitudinal axis of a preferred embodiment of the present invention whilst cutting a groove. The direction of rotation, frictional force and reaction force pointing into a channel are shown.

- 15 Figure 4 shows a view along the longitudinal axis of a drill bit where the blades precede the radius rather than trail it. The direction of rotation, frictional force and reaction force pointing out of a channel are shown.

For the purposes of clarity and a concise description features are described herein as

- 20 part of the same or separate embodiments, however it will be appreciated that the scope of the invention may include embodiments having combinations of all or some of the features described.

A preferred embodiment of a drill bit according to the invention is shown in figures 1 and 2. The drill bit comprises a crown (6); a shank (7) which extends from the crown (6); a collar (9) adjacent the shank (7) distal to the crown (6); and an attachment portion (8) adjacent the collar (9) and distal to the crown (6). The drill bit has a TiNO<sub>3</sub> coating.

The shank (7) is coaxial with the crown (6) and is of significantly smaller diameter than the crown (6).

10 The crown (6) comprises a cutting tip (1) on its central longitudinal axis. The cutting tip (1) comprises a pyramid having a base and three sides each tapered to a 30° point. In addition, the crown (6) comprises three identical cutting blades which extend radially from the central longitudinal axis of the crown. The cutting blades are separated from each other by an angle of 120°.

15

Each cutting blade comprises a first axially cutting face having a first axially cutting edge (2); and a second axially cutting face having a second axially cutting edge (5).

The first and second axially cutting faces oppose each other and the first and second cutting edges are for cutting in opposite directions. The first axially cutting face

20 bisects a radial plane of the crown at an angle of about 15°. The second axially cutting face bisects a radial plane of the crown at an angle of about 5° to about 10°. In

10 :

addition, the second axially cutting face bisects an axial plane of the crown at an angle of about 5° to about 10°.

In addition, each cutting blade comprises a wedge shaped wing that extends

- 5 circumferentially from the end of each blade distal to the central longitudinal axis of the crown. Each wing extends circumferentially from the face of a blade adjacent the first axially cutting edge. The projecting edge of each wing forms a radially cutting edge (4). The radial cutting edge (4) bisects an axial plane of the crown (6) at an angle of 18°.

10

The radially outer face of the wing bisects a circumferential plane at an angle of 3° so that the wing is radially more distant from the central longitudinal axis of the crown adjacent the first axially cutting face than adjacent the second axially cutting face.

- 15 In addition, each cutting blade comprises a wedge shaped tooth located atop the join between a wing and a first axially cutting face. Each tooth has a third axially cutting face having a third axially cutting edge (3). The third axially cutting edge (3) is provided adjacent the first axially cutting edge (2). Furthermore, the third axially cutting edge is curved from a first end where it meets the radially cutting edge to a
- 20 straight portion at its opposing end.

It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the present invention and without diminishing its attendant advantages. It is  
5 therefore intended that such changes and modifications are covered by the appended claims.

**Claims**

1. A drill bit comprising a crown and a shank extending from the crown, wherein the crown comprises at least three cutting blades.

5

2. A drill bit according to claim 1 having an odd number of cutting blades.
3. A drill bit according to claim 2 wherein the crown comprises three cutting blades.
- 10 4. A drill bit according to claim 3 wherein the three cutting blades are disposed from the longitudinal axis of the drill bit at an angle of  $120^\circ$  with respect to each other.
5. A drill bit according to any preceding claim wherein each cutting blade is identical.

15

6. A drill bit according to any preceding claim wherein each cutting blade comprises a first axially cutting face, a radially cutting face and a second axially cutting face.
- 20 7. A drill bit according to claim 6 wherein each cutting face comprises at least one cutting edge.

8. A drill bit according to claim 7 comprising a first axially cutting face having a first axially cutting edge that bisects a radius of the crown.
9. A drill bit according to claim 8 wherein the first axially cutting edge trails the radius of the crown, relative to the intended direction of rotation for cutting.
10. A drill bit according to claim 8 or 9 wherein the trailing edge of the first axially cutting face lies on a radius of the crown.
11. A drill bit according to any preceding claim comprising a cutting blade having a wing.
12. A drill bit according to claim 11 wherein the wing is wedge shaped.
13. A drill bit according to claim 11 or 12 wherein the wing extends circumferentially from the end of each blade distal to the central longitudinal axis of the crown.
14. A drill bit according to any one of claims 11 to 13 wherein the wing has a curved outer face.

15. A drill bit according to any one of claims 11 to 14 wherein each wing extends circumferentially from the face of a blade adjacent the first axially cutting edge and the projecting edge of each wing forms a radially cutting edge.
- 5 16. A drill bit according to any preceding claim wherein each cutting blade is provided with a wedge shaped tooth that projects from the blade in an axial direction to a greater extent than the first axially cutting face.
- 10 17. A drill bit according to claim 16 wherein the tooth tapers to form a third axially cutting edge.
18. A drill bit according to claim 17 wherein the third axially cutting edge is provided proximal to the first axially cutting edge.
- 15 19. A drill bit according to claim 18 wherein the third axially cutting edge is curved from a first end where it meets the radially cutting edge to a straight portion at its opposing end on top of the crown.
- 20 20. A drill bit according to any preceding claim wherein the crown comprises an axial tapered cutting tip positioned on the longitudinal axis of the drill bit wherein the cutting tip projects in an axial direction further from the shank than any other part of the crown.

21. A drill bit according to claim 20 wherein the cutting tip is tapered at an angle of about 20° to about 40°.

5 22. A drill bit according to claim 20 or 21 wherein the tapered cutting tip is pyramidal and has three sides, each tapered at an angle of about 20° to about 40°.

23. A drill bit according to any preceding claim comprising an attachment portion for a drilling machine positioned adjacent the shank distal to the crown.

10

24. A drill bit according to claim 23 wherein the attachment portion is of a wider diameter than the shank.

15

25. A drill bit according to claim 24 comprising a collar between the shank and the attachment portion, increasing in diameter from that of the shank to that of the attachment portion.

26. A drill bit according to claim 25 wherein the collar has a rough texture for providing grip.

20

27. A drill bit according any preceding claim comprising a titanium nitrate (TiNO<sub>3</sub>) coating.

28. A drill bit according to any preceding claim that comprises 1060 high carbon steel and is of the hardness HRC 45-55.
- 5 29. A drill bit substantially as described herein with reference to or as illustrated in any of the figures of the accompanying drawings.

1/4

Figure 1

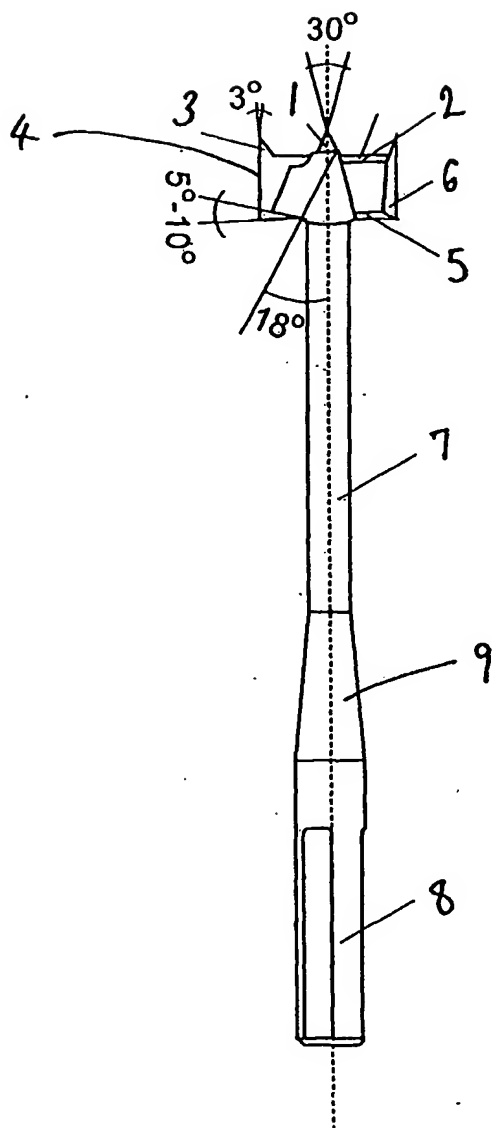


Figure.2

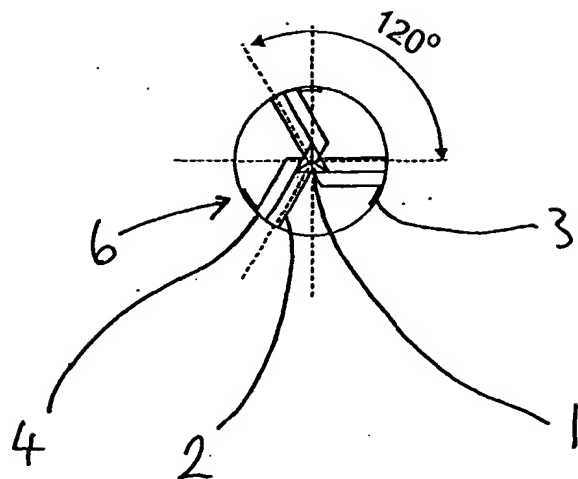
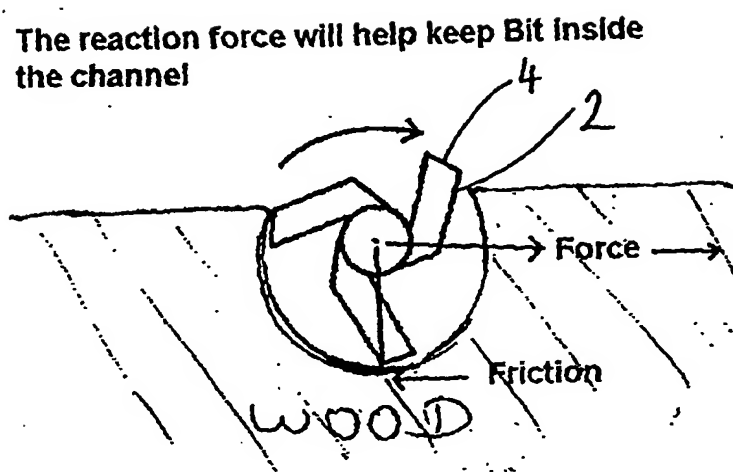
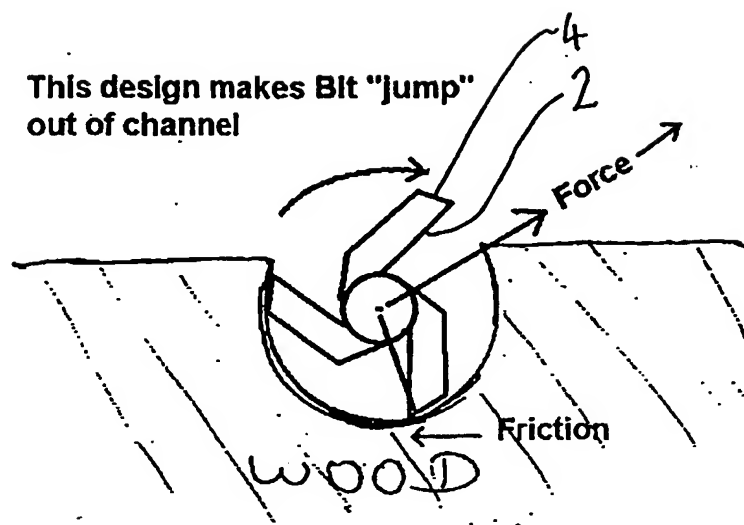


Figure 3



4/4

Figure 4



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 03/00087

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 B27G15/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B27G B23B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 219 229 A (KWO WERKZEUGE GMBH) 6 December 1989 (1989-12-06) page 7, line 6 - line 29; figures 1-3	1-26, 29
Y	---	27, 28
Y	US 6 325 806 B1 (FOX WILLIAM CASEY) 4 December 2001 (2001-12-04) column 11, line 4 - line 7; figure 5	27
Y	US 3 988 955 A (ANDERSON EUGENE A ET AL) 2 November 1976 (1976-11-02) column 3, line 28 - line 31 column 4, line 55 - line 61; claim 1	28
X	US 1 446 194 A (MCCULLOUGH JOHN T) 20 February 1923 (1923-02-20) the whole document	1-5, 20, 23
	---	
	-/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*G\* document member of the same patent family

Date of the actual completion of the international search

24 Apr11 2003

Date of mailing of the international search report

06/05/2003


Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2260 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax (+31-70) 340-3016

Authorized officer

Huggins, J

## INTERNATIONAL SEARCH REPORT

Intern  Application No  
PCT/GB 03/00087

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2001/031180 A1 (HASAN MAZ A ET AL) 18 October 2001 (2001-10-18) paragraph '0046!; figures ----	1,2,5-7, 11-15
A	EP 0 181 841 A (JANSSON LARS OVE) 21 May 1986 (1986-05-21) cited in the application the whole document ----	1
A	GB 857 366 A (CRUCIBLE STEEL CO AMERICA) 29 December 1960 (1960-12-29) page 4, line 41 - line 56; claim 1 ----	28
A	EP 0 418 077 A (VERMONT AMERICAN CORP) 20 March 1991 (1991-03-20) ----	
A	EP 1 034 866 A (TIGRA HARTSTOFF GMBH) 13 September 2000 (2000-09-13) -----	

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 03/00087

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2219229	A	06-12-1989 IT 1234142 B	04-05-1992
US 6325806	B1	04-12-2001 US 6071284 A	06-06-2000
		AU 714657 B2	06-01-2000
		AU 5427196 A	22-05-1997
		BR 9611373 A	28-12-1999
		EP 0859570 A1	26-08-1998
		JP 11514905 T	21-12-1999
		NO 981940 A	29-06-1998
		NZ 306102 A	25-11-1998
US 3988955	A	02-11-1976 AT 352372 B	10-09-1979
		AT 1017474 A	15-02-1979
		CA 1041881 A1	07-11-1978
		CH 587702 A5	13-05-1977
		DE 2504817 A1	01-04-1976
		DE 7503466 U1	07-12-1978
		DK 649274 A	12-03-1976
		FR 2284408 A1	09-04-1976
		IE 40786 B1	15-08-1979
		IT 1035546 B	20-10-1979
		JP 51035180 A	25-03-1976
		SE 7500377 A	12-03-1976
		ZA 7407567 A	27-10-1976
US 1446194	A	20-02-1923 NONE	
US 2001031180	A1	18-10-2001 CA 2327937 A1	10-06-2001
EP 0181841	A	21-05-1986 SE 454757 B	30-05-1988
		AT 65045 T	15-07-1991
		AU 583047 B2	20-04-1989
		AU 4581085 A	13-02-1986
		CA 1257113 A1	11-07-1989
		DE 3583426 D1	14-08-1991
		DE 181841 T1	24-08-1989
		EP 0181841 A2	21-05-1986
		ES 296201 U	16-12-1987
		JP 2056179 C	23-05-1996
		JP 7090407 B	04-10-1995
		JP 61044518 A	04-03-1986
		SE 8404027 A	09-02-1986
		US 4753558 A	28-06-1988
GB 857366	A	29-12-1960 NONE	
EP 0418077	A	20-03-1991 US 5099933 A	31-03-1992
		CA 2025128 A1	14-03-1991
		EP 0418077 A2	20-03-1991
		US 5145018 A	08-09-1992
EP 1034866	A	13-09-2000 DE 19910580 C1	27-07-2000
		AT 223779 T	15-09-2002
		DE 50000463 D1	17-10-2002
		EP 1034866 A2	13-09-2000
		PT 1034866 T	31-01-2003
		US 6206062 B1	27-03-2001